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The Use of Urine Biomarkers to Estimate Population Sodium Intake

Population sodium intake is typically estimated in one of two ways: (1) self-reported dietary intake data (e.g., 24-hour [h] dietary recalls, food records, diaries, food frequency questionnaires) and (2) urine biomarkers (e.g., 24-h urine collection, spot urines). Urine biomarker data can better capture all sources of sodium intake (i.e., foods, salt added at the table, medications, etc.) and can be more accurate than self-reported food intake data.

> "Federal agencies should ensure and enhance monitoring and surveillance relative to sodium intake measurement… and should ensure sustained and timely release of data in user-friendly formats."
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> —Institute of Medicine, *Strategies to Reduce Sodium Intake,* 2010

The Centers for Disease Control and Prevention (CDC) is working with other federal agencies to better understand the potential and optimal utilization of urine biomarker data to monitor the amount of sodium consumed. The National Institutes of Health (NIH) defines "biomarker" as "a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention."

CDC has been working in collaboration with NIH and university partners to identify surveillance methodologies that are feasible to implement and provide valid and reliable results that are representative of the population. Below is a summary of key take-aways and future research considerations related to urinary sodium excretion and measurement of sodium intake.

Key Take-Aways

A single, spot urine specimen may provide an alternative when estimating <u>average</u> *population* sodium intake in young, healthy, Western adults, but questions remain about their usefulness for estimating the prevalence of excess sodium intake and their use in older adults and in children. Monitoring population sodium intake and assessing the effectiveness of population efforts to reduce sodium intake requires population-based surveys. Because sodium levels in the body can fluctuate throughout the day, measurement of 24-h urinary sodium excretion is the preferred population-based survey method; however, collection of 24-h urinary sodium excretion can be expensive and burdensome to participants. Considerations when capturing 24-h urine collections from individuals include willingness of participants and within-person variability. Estimating sodium excretion (and thus intake) from casual (spot) urine specimens is cheaper and less burdensome but has not been extensively studied for use in estimating population sodium intake. Results of a CDC co-authored study, "Estimating 24-hour urinary sodium excretion from casual urinary sodium concentrations in Western populations: the INTERSALT study," which looked at samples of 5,693 adults aged 20–59 years, suggest casual (spot) urine specimens may be sufficient when estimating average population sodium intake among healthy Western adults, but not when estimating individual sodium intake.

Spot urine specimens are not recommended for estimating individual sodium intake because the amount of sodium excreted varies throughout the day and from day to day. Conducting 24-h urinary sodium collections in national surveys, such as the National Health and Nutrition Examination Survey (NHANES), can be logistically complex, require additional respondent burden, and incur a high cost. Alternative strategies to monitoring population sodium intake do exist, but they must be validated. A urine calibration study, "Urinary excretion of sodium, potassium, and chloride, but not iodine, varies by timing of collection in a 24-hour calibration study," was designed to assess the ability to estimate sodium intake from timed-spot urine samples calibrated to a 24-h urine collection among adults aged 18–39 years. Significant day-to-day and diurnal variations in sodium excretion were observed and must be considered when developing and using calibration equations to estimate sodium intake.

The INTERSALT estimation equations work well for estimating average population sodium intake in young adults living in the United States when used with timed spot urines collected in the morning, afternoon, or evening. Although the INTERSALT study suggested a casual (spot) urine specimen may be used to estimate average population sodium intake, the equations were developed and validated among white adults. Daily patterns of sodium excretion vary by race. An analysis of a urine calibration study, "Validity of predictive equations for 24-hour urinary sodium excretion in adults aged 18–39 years," assessed the validity of the INTERSALT and other published calibration equations used to estimate 24-h urinary sodium excretion from spot urine collections among black and white adults aged 18–39 years. Results indicate that a direct approach using spot urine sodium concentration, age, and body mass index, with separate equations by sex, was least biased when predicting average 24-h urine sodium excretion among blacks and whites. The INTERSALT equation demonstrated the least bias with morning, afternoon, and evening specimens. Other equations provided less bias on overnight samples, but only with particular segments of the population. All of the equations assessed in this study were significantly biased when estimating *individual* sodium intake.

Considerations for Future Research

- Average 24-h urinary sodium excretion is generally considered the gold standard for accurately estimating population sodium intake because this method, when collection is complete, accounts for at least 90% of dietary sodium intake.
- Developing and validating equations that adequately predict population sodium intake across low and high levels may allow us to assess the prevalence of excess sodium intake.
- Study- or survey-specific calibration of spot urine specimens to estimate average 24-h urinary sodium excretion is recommended to increase the validity of estimates.
- Developing and validating calibration equations using spot urine samples among older adults and individuals with hypertension is important due to potentially different patterns of sodium excretion with older age and higher blood pressure.

Upcoming Research

- CDC and NIH plan to implement 24-h urine collection in a subsample of adults in NHANES 2014, having completed a CDC/NIH pilot study that assessed feasibility of 24-h urine collection and laboratory analysis in NHANES.
- NIH, in collaboration with CDC, is conducting a urine calibration study among adults aged 45–79 years, including individuals with hypertension.

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